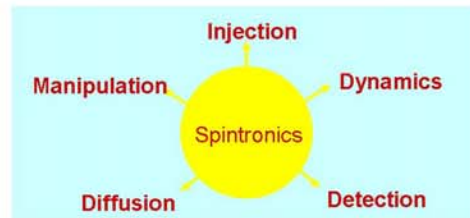


# Non-local spin injection in lateral spin valves

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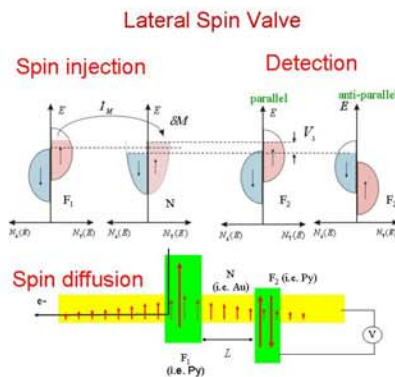
## Motivation

- Spintronics is future for electronics
- Leading to new physics (e.g. spin Hall effect)
- Short spin relaxation requires lateral nanometer and/or temporal picosecond scale
- Lateral spin transport is a highly desired but less explored



- Using spin degree of freedom holds promise for increased energy efficiency
- Already applied in computer hard drives and non-volatile memory
- Integration of spintronic devices require lateral spin transport

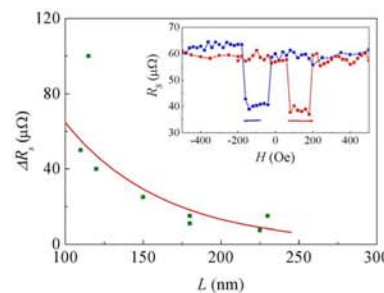
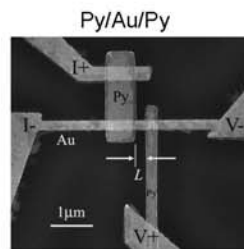
## Accomplishments



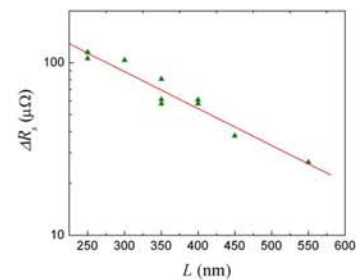
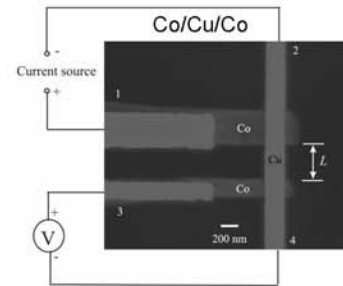
$$\Delta R_x = \frac{V_z}{I_e} = \frac{P_1 P_2 \rho_2 \lambda_s}{A} e^{-\frac{L}{\lambda_s}}$$

$\lambda_s$ : spin diffusion length  
 $P$ : injected spin polarization

Y. Ji et al., APL 85, 6218 (2004)



$\lambda_s = 63$  nm, Au at 10 K  
 $P = 3\%$  for Py/Au interface



$\lambda_s = 200$  nm, Cu at 10 K  
 $P = 7\%$  for Co/Cu interface

## Outlook

### New Materials

#### Goals

- Long spin diffusion length
- Higher injected polarization

#### Opportunities

- Magnetic thin films (MSD)
- Complex Oxide (MSD)
- Organic Materials (U of C)
- Nanofabrication (CNM)

#### Proposed work

- Use half-metal as injector: Manganites
- Injection through a tunnel barrier

### New concepts

#### Goals

- Modulation of spin accumulation
- Switching by pure spin current

#### Opportunities

- One of the few groups worldwide that can fabricate lateral spin transport devices
- Characterization tools: X-ray microscopy

#### Proposed work

- Three terminal device to control spin accumulation
- Switch a magnet by a pure spin current
- Direct imaging of spin accumulation
- Measure spin diffusion length in ferromagnets
- Spin torque transistor

### New physics

#### Goals

- Spin scattering in transport
- Spin-transfer torque
- Excitation of spin dynamics

#### Opportunities

- Time resolved PEEM (ALS)
- RF expertise (MSD)
- Theoretical collaborators (through MTI: Delft, IBM)

#### Proposed work

- Magnetization precession
- Spin echo
- Spin Hall effect

Y. Ji, A. Hoffmann, J. E. Pearson, and S. D. Bader, Applied Physics Letters 88, 052509 (2006)